New Tall Fescue Varieties for the Future

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Over the past few decades forage producers have seen several major changes in varieties of tall fescue. From the days of Kentucky 31 being the predominant variety, the first change was the first generation of endophyte-free tall fescue varieties. For many growers, these have been useful additions, especially when coupled with rotational grazing to reduce the risks of overgrazing, and practices of eradication of stands of toxic endophyte pastures and prevention of the reintroduction of toxic endophyte tall fescue seed into stands of endophyte-free varieties. However, overall these varieties often lacked the persistence of Kentucky 31 infected with the common toxic strain of endophyte, and disappointed many early adopters. In the 25-30 years since the first generation of endophyte-free varieties, plant breeders have made progress in developing additional populations with a greater range of diversity, and improved varieties are still being developed, and will be developed.

A second area of new varieties has been from wide hybridization efforts (most are also endophyte-free as well). Wide hybridization with tall fescue involves crossing close relatives of tall fescue. Tall fescue has three genomes, or ancient parents, and some existing relatives have similarity to one or more of these. Popular species used to cross with tall fescue include meadow fescue, giant fescue, perennial ryegrass, annual ryegrass. Other species such as the drought-tolerant *Festuca mairei* can be used, and forage grass breeders in Europe are likely to want to transfer tall fescue genes into ryegrass. Early goals for wide hybridization were to combine all of the chromosomes from both parents into new species, similar to triticale resulting from combining wheat and rye. Most successful varieties have been similar to Kenhy and Johnstone were: hybrid derivatives that are essentially tall fescue with a few genes from the other parental species (examples include several lines from Europe such as Hykor, Fojtan, and Felina).

Two groups of forage breeders have been successful in improving palatability in tall fescue. Workers in New Zealand and with Barenbrug have developed several varieties with softer leaves such as Advance, Bariane, Barcel, and Barolex. These varieties tend to have finer texture than Kentucky 31, and have fewer siliceous barbs on the edges of the leaf blades. Persistence and drought tolerance have been somewhat lower than in traditional tall fescue varieties.

Maturity of these varieties is later than other types, so preference ratings during the heading period are confounded with maturity. In grazing tolerance trials, these soft-leaved, late maturing varieties tend to get overgrazed due to higher preference.

Some Mediterranean-type tall fescue varieties have been tested in university forage trials in recent years. These varieties tend to have strong summer dormancy, but some others can be productive as long as moisture levels are adequate. Summer dormant, winter active tall fescues can extend the grazing season, but winter hardiness may be a concern in the northern parts of the tall fescue belt.

During the past 20 years, plant explorers have collected several hundred new accessions of tall fescue from North Africa and southern Europe. Some of these are not the same as our continental Kentucky 31 type tall fescue which has 42 chromosomes. The new accessions have chromosome numbers that include 28, 42, 56, and 70. Much of this material was collected specifically in search of novel endophytes, but it could be used to build new varieties that are distinctly different from standard tall fescue, with improved drought tolerance, disease resistance, and winter activity. Some of these accessions can be used in crosses with meadow fescue or ryegrass to produce totally new combinations (French researchers have released several varieties of this type: e.g. Lueur and Luxane).

In 2000, the first commercial sales of a non-toxic endophyte in a tall fescue variety began with Jesup-MaxQ (Table 1.). We have had over a decade of experience to prove the concept that novel endophytes producing no harmful ergot alkaloids (or at least, lower levels) can give benefits to producers. Generally, the goals for NETFs is to have greater persistence than endophyte-free varieties, but provide animal performance results comparable to endophyte-free varieties. The second novel endophyte strain marketed in the USA was from the University of Arkansas and University of Missouri (strain #4) in HiMag tall fescue, sold as ArkPlus. This material is newly re-available as Estancia/ArkShield. Barenbrug tested and released a strain of beneficial endophyte, Plus34, that produces lower levels of ergot alkaloids than the common toxic strain in Kentucky 31, as BarOptima. In 2011 three new NETF varieties came on the market: Estancia/ArkShield, Texoma MaxQII, and DuraMax/Armor. Texoma MaxQII has strain AR584 in it, with greater survival of the endophyte in stored seed and excellent plant benefits. DuraMax from Auburn University has more winter activity and uses one or two strains licensed from the University of Arkansas and has not been tested widely yet. At the University of Kentucky, progress has been made in engineering the toxic endophyte in Kentucky 31 to be harmless, but this work has not been completed by Dr. Chris Schardl's group in the Department of Plant Pathology. As soon as both functional copies of the ergot alkaloid pathway have been removed or knocked

out, the engineered strain will be inserted into elite U.K. tall fescue varieties for evaluation and commercialization.

Table 1. Novel endophyte tall fescue commercial products, 2000-2011.

Year of 1st Sales	Cultivar	Tall Fescue Owner	Endophyte Brand	Strain I.D.	U.S. Patent #	Endophyte Owner	USA Marketer
2000	Jesup	Univ Georgia	MaxQ	AR542	6,111,170	Grasslanz	Pennington Seed
2007	BarOptima	Barenbrug	Plus E34	E34	7,642,424	Barenbrug	Barenbrug USA
2011	Texoma	Noble Foundation	MaxQ II	AR584	6,111,170	Grasslanz	Pennington Seed
2011	Estancia	Univ Missouri	ArkShield	#4	7,465,855 7,553,654 7,977,550	Univ Arkansas	Mountain View Seeds
2011	DuraMax	Auburn Univ	Armor	#9 or #12	7,465,855 7,553,654 7,977,550	Univ Arkansas	DLF International Seeds

Current breeding strategies in novel endophyte tall fescue include selection within current NETF varieties and populations and continued development of improved endophyte-free or toxic endophyte-containing populations that will have a novel endophyte strain inserted after removal of any toxic endophyte in the germplasm. Strain crosses can be used to combine the benefits of the novel endophyte with other varieties (such as soft-leaved or turf-type high seed yield lines) by using the NETF parents as females and pollinating with males from another source. Perhaps selection from existing novel endophyte varieties will allow better grass-endophyte compatibility, higher speed transmission of the endophyte, and better performance of varieties that are produced in this manner.